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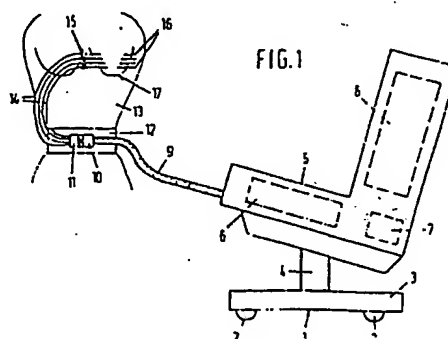
71 Applicant: Van 't Hooft, Eric
Gezichtslaan 16
NL-3956 BB Leersum(NL)

72 Inventor: Van 't Hooft, Eric
Gezichtslaan 16
NL-3956 BB Leersum(NL)

74 Representative: Urbanus, Henricus Maria, Ir. et al,
c/o Verenigde Octrooibureaux Nieuwe Parklaan 107
NL-2587 BP 's-Gravenhage(NL)

64 A method and an apparatus for treating a part of the body with radioactive material.

67 A method and an apparatus for treating a part of the body of a patient with radioactive material, in which at least one hollow needle is introduced into the part of the body concerned, said needle being capable of subsequently receiving a tube containing selectively positioned radioactive material, previously arranged therein. Use is made of a cart comprising at least one tube containing selectively positioned radioactive material, an intermediate container for shielding the tube or tubes, and means for transporting the said tube with radioactive material into and out of the shielding means. According to the present invention, each implant needle is connected to the cart by means of a patient transfer tube with a patient connector and a machine connector connected with a plurality of external tubes, from which cart tubes are selectively inserted into the needle or needles already introduced by means of one or more transport threads movable in the patient transfer tubes.



Title: A method and an apparatus for treating a part of the body with radioactive material.

This invention relates to a method of treating a part of the body of a patient with radioactive material, in which at least one hollow needle is introduced into the part of the body concerned, said needle being capable of subsequently
 5 receiving a tube containing selectively positioned radioactive material previously arranged therein, while using a cart comprising at least one tube containing selectively positioned radioactive material, an intermediate container for shielding the tubes and means for transporting the said
 10 tube with radioactive material into and out of the shielding means.

It is an object of the present invention to improve such a generally known method.

To this end, the method according to the invention
 15 is characterized in that each implant needle is connected to the cart by means of a patient transfer tube having a patient connector and a machine connector connected with a plurality of external tubes, from which cart tubes are selectively inserted into the needle or needles already
 20 introduced.

The positioning can take place by means of a transport thread movable in the patient transfer tubes and the final position can be detected pneumatically by shutting off an

air passage bounded by a shoulder, by means of a control head attached to each tube. This enables a highly accurate positioning of the radioactive material without the risk for the operator to be exposed to radiation.

5 A further improvement is obtained when the machine connector can be connected to a container connector of a storage container from which tubes can be selectively shifted into the cart.

10 The present invention further relates to a cart for use in the performance of the above described method, said cart being fitted with an intermediate container having a plurality of curved passages, there being arranged behind each passage a drive mechanism and a control mechanism.

15 The drive mechanism may comprise a drivable disc having a spiral groove, said groove accommodating a transport thread whose front end is adapted for coaction with a member, e.g. a tube, containing selectively positioned radioactive material, previously arranged therein.

20 In order to connect the transport thread to the tube with radioactive material the transport thread may have a gripper adapted for detachably receiving a head connected to one end of the tube.

25 A proper guidance of the transport thread is obtained when the disc is accommodated in a housing, one sidewall of which is fitted with a curved radial slot receiving a support having a transport thread guide channel, said support

being arranged to be guided by the groove by means of a rotary arm mounted on the housing.

The support may be provided at its bottom with a tongue or lip adapted for coaction with the spiral groove
5 in the disc. The arm may have a transport thread guide channel at the side facing the disc.

The drive of the disc can be effected by fitting the outer circumference of the disc with worm wheel teeth adapted for coaction with a drivable worm arranged within
10 the housing.

The present invention further relates to the drive mechanism per se described hereinbefore.

With the cart described in the above, the positioning of the radioactive material takes place by means of a drive
15 mechanism having a motor and being remotely controlled. A substantial simplification of the apparatus is obtained when use is made of a cart having an intermediate container fitted with a plurality of bent passages, which are continuous and through which can be moved a transport thread, one end
20 of which is fitted with a pusher and the other end with a pulling member or gripper adapted for detachably receiving a head connected to one end of the tube with radioactive sources, while a control head attached to each tube is adapted for coaction with a shoulder of the needle:
25 accordingly, this apparatus does not have a drive mechanism and the tubes with sources are positioned substantially

manually.

By having the length of the flexible thread correspond substantially with the length of the patient transfer tubes, it is possible after the retraction of the transport thread
5 and the disconnection of the machine connector and the patient connector, to provide the free end of the latter with a cover: As a result, the flexible thread and hence the tube with radioactive sources is fixedly confined on the one hand by the control head and on the other hand by the head
10 between a stop of the needle connector on the one hand and the said cover on the other hand.

A proper attachment of the flexible thread and the tube with radioactive sources, fixedly connected to the thread, within the intermediate container is ensured by
15 providing the free end of each passage in the intermediate container with a restriction through which the head but not the shoulder of the flexible rod can be moved, the rod linking up with the said projecting head being adapted for coaction with a blocking bracket.

20 The method and apparatus according to the invention have the advantage that the radioactive material can be brought accurately and without the risk of contamination of the operator, at the proper place in the body of a patient.

One embodiment of an apparatus for treating the part
25 of a body with radioactive material will now be described, by way of example, with reference to the accompanying

drawings, in which:

Fig. 1 is a diagrammatic side view of an apparatus for treating the part of a body with radioactive material;

Fig. 2 shows a storage container employed when using
5 the apparatus shown in Fig. 1;

Fig. 3 shows an enlarged detail of the apparatus shown in Fig. 1;

Fig. 4 shows an enlarged detail of the apparatus shown in Fig. 3;

10 Fig. 5 shows a perspective bottom view of the guide;

Fig. 6 shows an enlarged detail of the apparatus shown in Fig. 1;

Fig. 7 shows the enlarged transport thread with coupling elements used in the apparatus shown in Figs. 1-6
15 for transporting radioactive material;

Fig. 8 is a perspective view of a second embodiment of the apparatus according to the invention;

Fig. 9 is a diagrammatic top view of a part of the apparatus shown in Fig. 8 when in operation;

20 Fig. 10 shows the enlarged detail A of the apparatus shown in Fig. 9;

Fig. 11 is a diagrammatic side view of a transport thread used in the apparatus shown in Figs. 8 and 9, and

Fig. 12 is a diagrammatic side view of a flexible rod
25 with a tube carrying the radioactive material.

As shown in Figs. 1-7, an apparatus for treating the

part of a body with radioactive material comprises a cart
1 with wheels 2 supporting a base 3 whereon a leg 4 is
mounted. Leg 4 carries a housing wherein, diagrammatically
shown, there are arranged an intermediate container 6, a
5 drive mechanism 7 and a control mechanism 8. The intermediate
container connects to an external tube 9 whose free end is
fitted with a machine connector 10. Said machine connector
10 is adapted for coaction by means of locking members, not
shown, with a patient connector 11 affixed to a patient belt
10 12 disposed on the body 13 of a patient to be treated. From
the patient connector, there extend a plurality of patient
transfer tubes 14, the ends of which are connected through
needle connectors 15 to implant needles 16 disposed in a
breast 17 of the patient.

15 The means necessary for treating a patient with
radioactive material further comprise a storage container
18 (see Fig. 2), which is fitted at the top with a plurality
of connectors 19 connecting to the passages, not shown,
provided within the storage container, said passages each
20 containing a tube with radioactive material. Storage container
18 is further provided with a support 20 to which there is
attached a container connector 21 corresponding with the patient
connector 11. The openings in the container connector 21 connect
to the bottom of a plurality of selection tubes 22 whose free
25 ends are fitted with selection tube connectors 23 adapted

for coaction with connectors 19.

As shown in Figs. 3, 4 and 5, the drive mechanism 7 comprises a disc 24 whose circumference has teeth 25 adapted for coaction with a worm 26, driven by a motor 27. The disc 5 24 is fitted at its top surface with a spiral groove 28 receiving a transport thread 29. Disc 24, worm 26 and motor 27 are received in a housing 30, not shown in Figs. 4 and 5 for the sake of clarity. Housing 30 contains an outlet 31 for the transport thread 29.

10 To ensure a proper discharge of the transport thread from the spiral groove 28 via the opening 31, there is provided in an upper plate 32 for the disc 24 a radial slot 33 wherein a support 34 can move (see the perspective bottom view shown in Fig. 5).

15 Support 34 is fitted with a guide channel 35 for the transport thread. As shown in Fig. 5, the support is fitted at the bottom with a lip 36 extending into the groove 28 of the disc, thus ensuring a proper guiding by the support.

The support is fitted at the top with a slot 58 where- 20 in a guide arm 37 is disposed whose one end is rotatably mounted on a shaft 38, which adjacent outlet 31 is attached to the upper plate 32. Furthermore, the guide arm 37 is fitted at the bottom with a groove 59 whose one end connects to the guide channel 35 in the support 34, its other end 25 connecting to the outlet 31 in the housing.

As further shown in Fig. 3, the outlet 31 connects to

a tube 39, which extends with a bent portion through the intermediate container 6. The other end of the tube 39 connects via a coupling 40 to a patient transfer tube 14. A number of such patient transfer tubes 14 are received in the external tube 9 (see Fig. 1): It is observed in this respect that the patient transfer tubes disposed on the body of the patient to be treated and those, contained in the external tube 9 are indicated by the same reference numeral, since the same patient transfer tubes are concerned here which are interconnected through machine connector 10, and the patient connector 11, respectively.

As shown in Fig. 3, the coupling 40 connects to a tube 41, which is connected to the pressure vessel 43 by means of a valve 42. Tube 41, upstream of the valve 42, is connected to a pressure transducer 44.

As shown in Fig. 6, the open end of the implant needle 16 is fitted in the needle connector 15, having a bore 45 fitted with a shoulder 46. Furthermore, bore 45 is also connected to an outlet 47.

Fig. 7 finally shows the free end of the transport thread 29, fitted with a gripper or similar crimp element 48 having gripper arms 49. Said arms 49 are adapted for coaction with a head 50 connected through a rod 51, a crimp element 52, a flexible rod 53 and a crimp element 54, to a tube 55 accommodating a plurality of radioactive sources 56.

Crimp element 54, at the side facing the tube 55, is fitted with a control head 57 adapted for coaction with shoulder 46 disposed in the needle connector 15 (see Fig. 6).

The apparatus is operated as follows.

5 When a patient has to be treated, after the required data have been entered into the control mechanism in a known manner, the cart is moved to the storage container 18 and the machine connector 10 is connected to the container connector 21. Subsequently, the selection tube connectors
10 23 are connected to the desired connectors 19. Then, the motor 27 of the drive mechanism 7 is put into operation, so that the transport thread 29 is moved out of the housing, with the gripper arm 49 at its front end in forward direction, via patient transfer tube 14, machine connector 10, container
15 connector 21, the chosen selection tube 22, selection tube connector 23, connector 19 into storage container 18. During this forward movement of the transport thread, an automatic coupling takes place between the gripper arms 49 and the head 50 of the tube 55 chosen, after which the transport
20 thread 29 is retracted until the tube 55 is present in the intermediate container 6. After all desired tubes 55 filled with radioactive sources 56 have thus been introduced in the intermediate container 6, the machine connector 10 is detached from the container connector 21, the cart 1 is
25 moved close to the patient and then the machine connector 10 is coupled to the patient connector 11.

The motor 27 is now restarted so as to move the transport thread with a tube containing radioactive sources on its free end in forward direction via patient transfer tube 14 received in external tube 9, machine connector 10, patient connector 11, patient transfer tube 14 on the body of the patient, needle connector 15 into implant needle 16 disposed in the breast 17 of the patient. By opening valve 42, air is introduced from pressure vessel 43 via tube 41 and coupling 40 into patient transfer tube 14: The air flows along the transport thread and escapes via outlet 47. However, as soon as control head 57 contacts shoulder 46, the pressure in tube 41 will increase, which is recorded by pressure transducer 44. Pressure transducer 44 is in communication via means not shown, with motor 27 and will cause the latter to stop when the pressure in tube 41 increases due to the abutment of control head 57 against shoulder 46. This naturally implies that tube 55 with radioactive sources 56 is at its proper place in implant needle 16.

After treating the patient, the motor 27 is re-energized so that the transport thread is again wound on disc 24 until each tube 55 filled with radioactive material is present in the intermediate container 6 and can be clamped therein. Subsequently, cart 6 is moved to storage container 18, after which tubes 55 filled with radioactive material are returned to the storage container in a manner

obvious after the foregoing.

In the above described manner, there is obtained an entirely closed transport system for the flexible transport thread, so that each time an accurate positioning of the tube 55 filled with radioactive material is possible without the risk of contamination of the operator.

Although nothing has been said in the above on given numbers of patient transfer tubes, transport threads, selection tubes, and the like, use is made in practice of a cart having an intermediate container accommodating 15 tubes. The number of patient transfer tubes 14 corresponds therewith. The storage container 18 may be provided with 45 connectors with communicating tubes for receiving therein a tube containing a source. It will be clear that the number of selection tubes in this case is also 15.

The second embodiment of the apparatus according to the invention, shown in Figs. 8-12, comprises a great many elements that correspond with those of the above described first embodiment: Corresponding parts are indicated by the same reference numerals. The perspective view illustrated in Fig. 8 shows a base 3 which, true, differs from that shown in Fig. 1, but which basically comprises the same elements. On the base there is mounted a housing 5 containing an intermediate container 6. The ends of the tubes 63 disposed in the intermediate container are basically freely accessible. Furthermore, the front of the intermediate

container 6 connects to an external tube 9 whose free end is fitted with a machine connector 10.

On the base 3, there is also provided an arm 66 whose free end is fitted with means 67 for retaining, in case of
5 non-use, machine connector 10 (shown in striped fashion in Fig. 8).

In the diagrammatic view shown in Fig. 9, the intermediate container 6 is only one of the 45 tubes 63. Said tubes connect to an external tube 9 accommodating a
10 number of patient transfer tubes, not further indicated, corresponding with the number of tubes, which patient transfer tubes terminate in machine connector 10. Said machine connector is adapted for coaction with patient connector 11 affixed to the patient belt 12 disposed on a leg of the
15 patient 13 to be treated. From the patient connector there extend a plurality of patient transfer tubes 14 whose ends are connected through needle connectors 15 to implant needles 16 introduced into the patient's uterus, not further indicated.

20 As shown in Fig. 10, each tube 63 may be fitted at its free end with a restriction 64 through which can pass the head 50 but not the shoulder 68 of crimp element 52 (see Fig. 12): In this position rod 51 is adapted for coaction with a blocking bracket 65, which may have any form but
25 which may be provided e.g. with a slotted opening of varying slot width.

As further shown in Fig. 11, for displacing the flexible rod 53 and the tube 55 with radioactive sources 56, use is made of a manual transport thread 60, one end of which is fitted with a pusher 61 and the opposite end
5 with a gripper 62, which is basically identical to the gripper 48 (see Fig. 7).

Since the operation of the apparatus will be clear after the above, this will not be further described herein.

It is finally observed that a great many modifications
10 are possible without departing from the scope of the present invention.

CLAIMS

1. A method of treating a part of the body of a patient with radioactive material, in which at least one hollow needle is introduced into the part of the body concerned, said needle being capable of subsequently receiving a tube
5 containing selectively positioned radioactive material previously arranged therein and in which use is made of a cart comprising at least one tube containing selectively positioned radioactive material, an intermediate container for shielding the tube or tubes and means for transporting
10 the said tube containing radioactive material into and out of the shielding means, characterized in that each implant needle is connected to the cart by means of a patient transfer tube with a patient connector and a machine connector connected with a plurality of external tubes, from
15 which cart tubes are selectively inserted into the needle or needles already introduced.
2. A method according to claim 1, characterized in that the positioning of tubes in needles takes place by means of a transport thread movable in the patient transfer tubes
20 and the final position is detected pneumatically by shutting off an air passage bounded by a shoulder, by means of a control head attached to each tube.
3. A method according to claim 1 or 2, characterized in that the machine connector is connected to a container

connector of a storage container from which tubes are selectively pushed into the cart.

4. A cart for use in the performance of the method according to claims 1, 2 or 3, comprising an intermediate
5 container having a plurality of bent passages, characterized in that a drive mechanism and a control mechanism are arranged behind each passage.

5. A cart according to claim 4, characterized in that the drive mechanism comprises a drivable disc having a
10 spiral groove accommodating a transport thread whose front end is adapted for coaction with a member, such as a tube, containing selectively positioned radioactive material previously arranged therein.

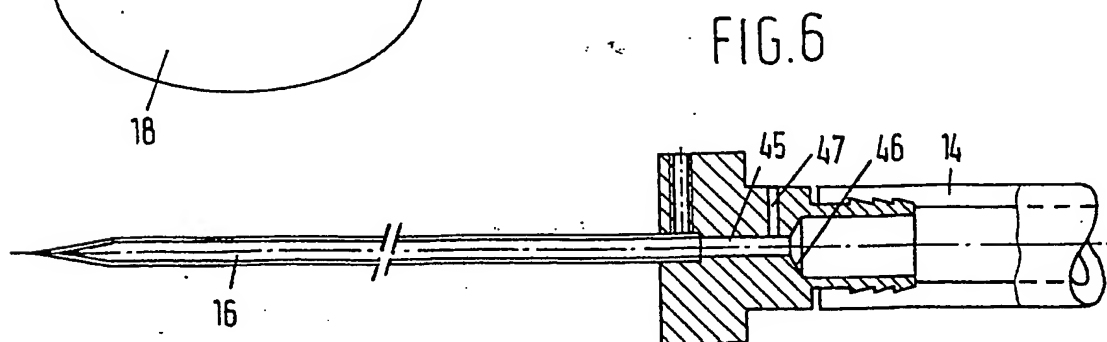
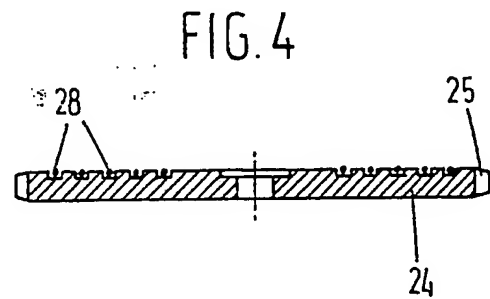
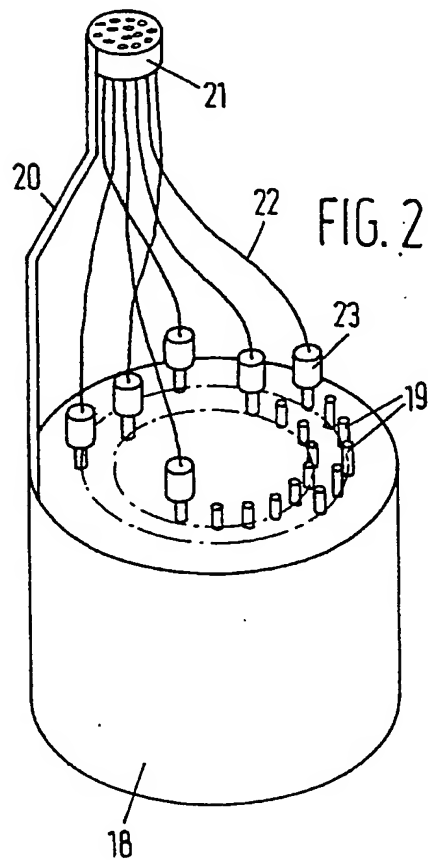
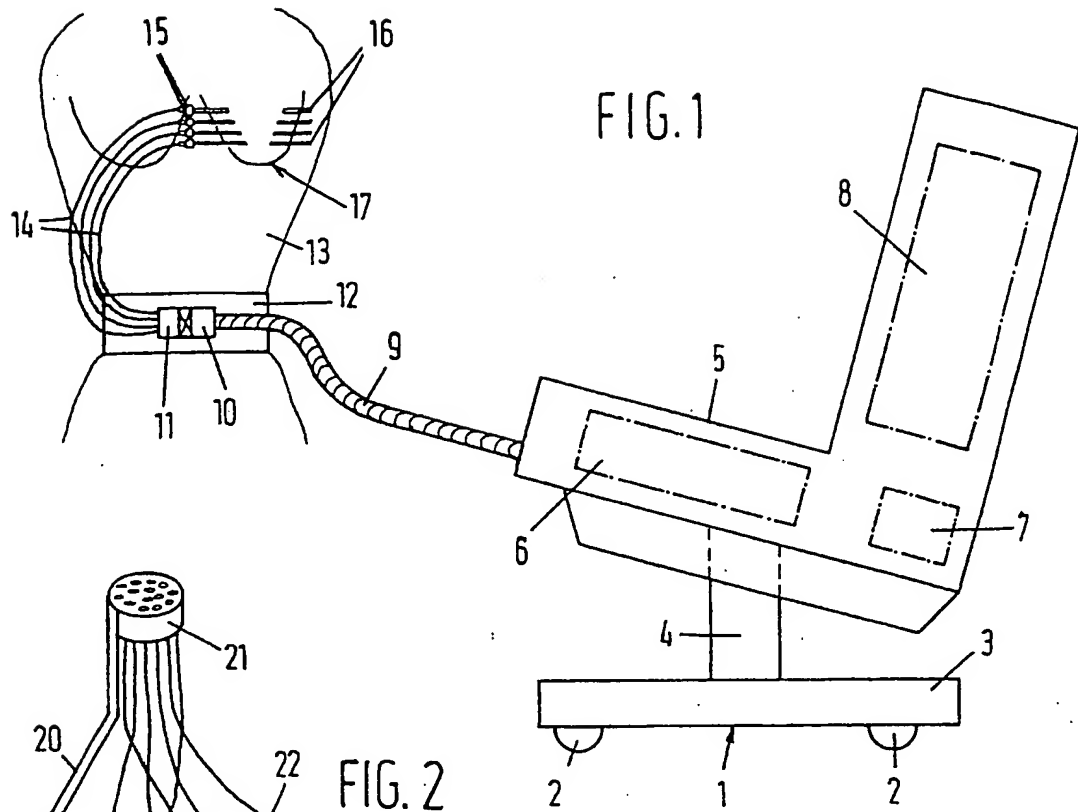
6. A cart according to claim 5, characterized in that
15 the free end of the transport thread is fitted with a gripper adapted for detachably receiving therein a head connected to one end of the tube.

7. A cart according to claim 5 or 6, characterized in that the disc is received in a housing, one sidewall of which
20 is fitted with a radial slot receiving a support fitted with a transport thread guide channel, said support being adapted to be guided through the channel by means of a rotary arm mounted on the housing.

8. A cart according to claim 7, characterized in that
25 the support is fitted at its bottom with a tongue or lip adapted for coaction with the spiral groove in the disc.

9. A cart according to claim 7 or 8, characterized in that the arm is fitted at its end facing the disc with a transport thread guide channel.
10. A cart according to claim 7, 8 or 9, characterized in that the disc is fitted at its outer circumference with worm wheel teeth adapted for coaction with a drivable worm arranged within the housing.
11. A drive mechanism as described in any one of claims 5-10.
12. A cart for use in the performance of the method according to claim 1 or 3, comprising an intermediate container having a plurality of bent tubes, characterized in that the tubes 63 are continuous and a transport thread 60 can be moved therethrough, one end of said thread having a pusher 61 and the other end a pulling member or gripper 62 adapted for detachably receiving therein a head 50 connected to one end of the tube 55 with sources 56, while a control head 57 attached to each tube is adapted for coaction with a shoulder 46 of the implant needle 16.
13. A cart according to claim 12, characterized in that the length of the transport thread 60 substantially corresponds with the length of the patient transfer tubes 14, there being provided a cover mountable on the patient connector 11.
14. A cart according to claim 12 or 13, characterized in that the free end of each tube 63 has a restriction 64

through which the head 50 but not the shoulder 52 of the flexible rod 53 can be moved, while the rod 51 connected to the said projecting head is adapted for coaction with a blocking bracket 65.



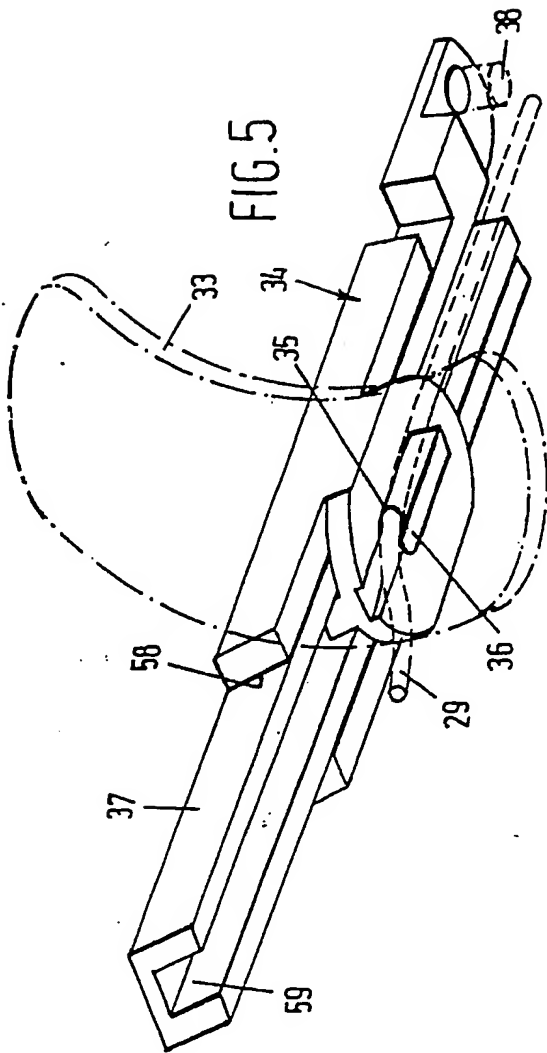


FIG. 5

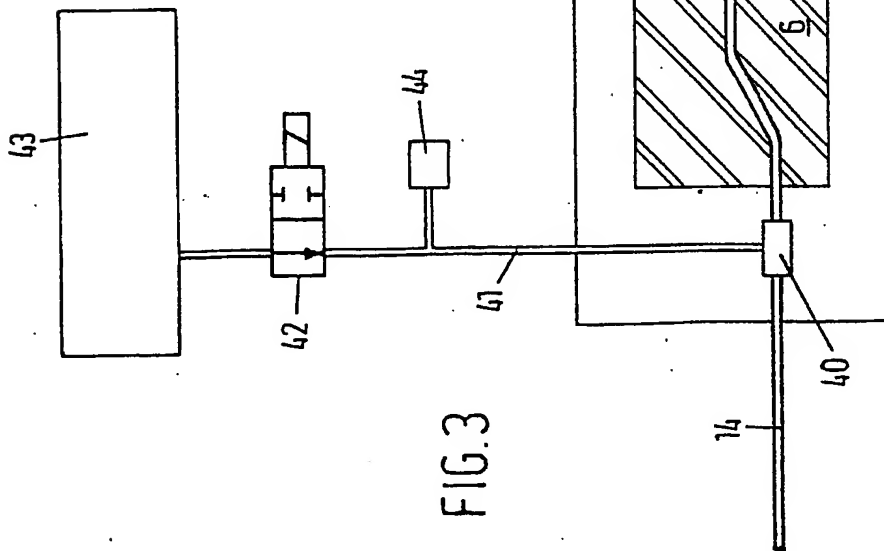


FIG. 3

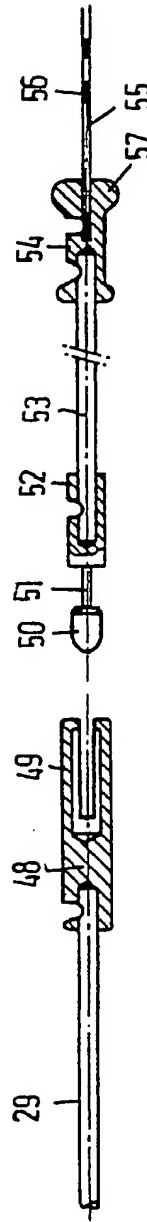
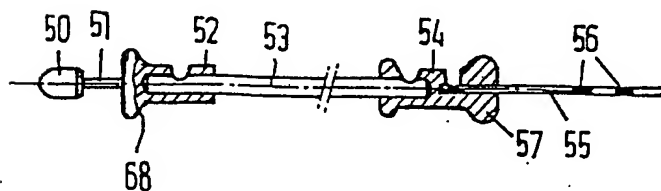
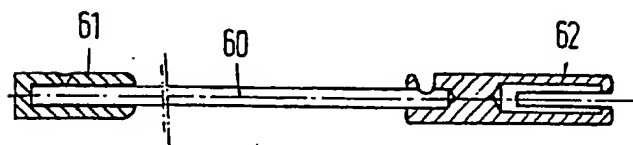
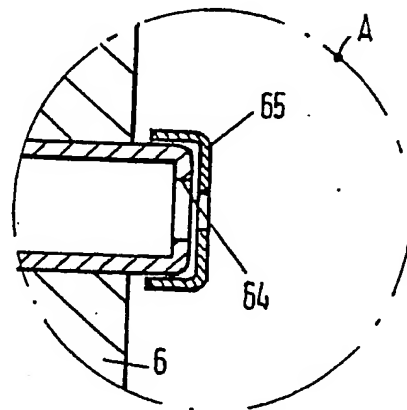
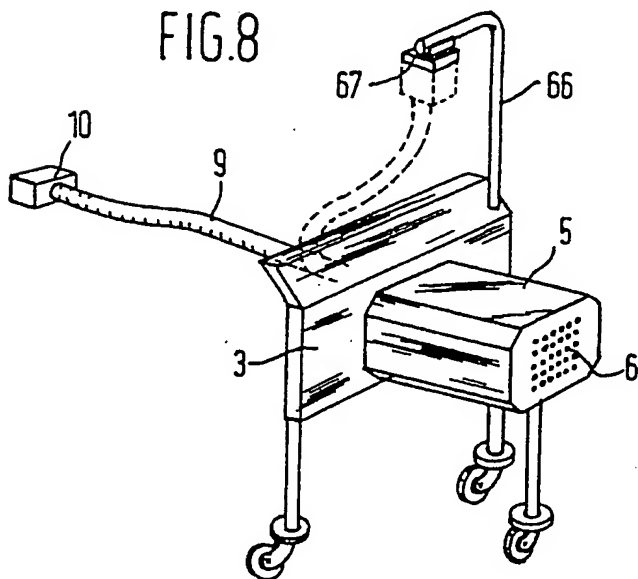
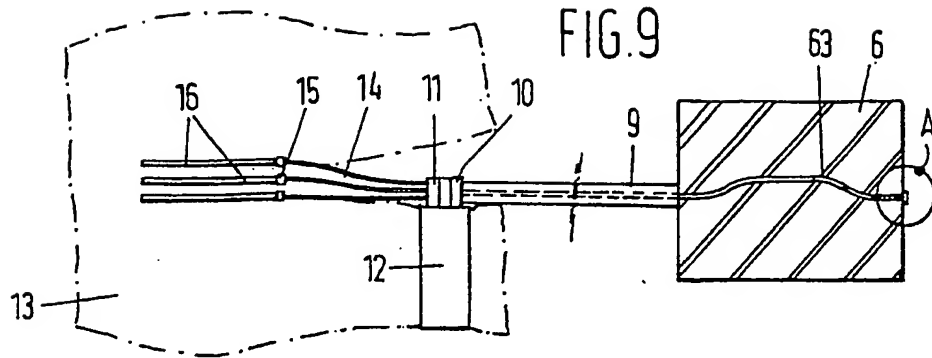


FIG. 7



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⑤④ A method and an apparatus for treating a part of the body with radioactive material.

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⑤⑥ References cited:
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DE-B-1 271 272
FR-A-1 031 219
FR-A-2 134 214
FR-A-2 348 714
FR-A-2 348 715
GB-A-1 027 078
GB-A-1 558 127
US-A-2 621 863
US-A-2 947 194
US-A-3 088 032

⑦③ Proprietor: Van 't Hooft, Eric
Gezichtslaan 16
NL-3956 BB Leersum (NL)

⑦④ Inventor: Van 't Hooft, Eric
Gezichtslaan 16
NL-3956 BB Leersum (NL)

⑦⑤ Representative: Smulders, Theodorus A.H.J., Ir.
et al
Vereenigde Octrooibureaux Nieuwe Parklaan
107
NL-2587 BP 's-Gravenhage (NL)

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Courier Press, Leamington Spa, England.

EP 0 152 124 B1

Description

This invention relates to an apparatus for positioning radioactive source material in at least one hollow implant needle implanted in the body of a patient comprising a container for storing at least one radioactive source assembly; said container containing radioactive source assemblies; a transfer tube having a first end connected to the container and a second end for connecting the tube via a needle connector with the at least one implant needle; mechanical means to drive the radioactive source assembly from the container through the transfer tube to the at least one implant needle.

Such an apparatus has been disclosed in FR—A—2134214.

In another such apparatus described in US—A—3,669,093 (Sauerwein) use is made of a shielding block for storing radioactive material movable by means of a spiral cable, through which radioactive material is introduced in a delivery tube having a closed end, which can be brought in an applicator disposed in the patient or other opening. The cart shown in this US patent is fitted with a transport mechanism arranged behind the curved passage in the shielding block, which mechanism does not include a drivable disc having a spiral groove, with the leading end of the transport thread being adapted to coact with the radioactive tube previously positioned selectively in the intermediate container. This apparatus lacks any sort of control mechanism other than the two photoelectric cells 12 and 13 which merely track the end positions of the transport thread end.

To overcome these drawbacks the apparatus according to the invention is characterized in that the needle connector has a bore fitted with a shoulder and connected to an outlet; a source of compressed air by which air is introduced into the transfer tube, the air passing through the transfer tube and escaping via outlet; a control head near the radioactive source assembly, which control head, adapted and configured to seat in said shoulder when the radioactive source assembly has been positioned in the at least one hollow implant needle and means to detect a pressure change in said transfer tube, which causes the mechanical drive means to stop when the pressure in the transfer tube increases due to abutment of control head against shoulder.

The positioning can take place by means of a transport thread carrying the radioactive source assembly; said transport thread fitted with a gripper having gripper arms adapted for coaction with a head; a head connected to the radioactive source assembly.

The apparatus can further include a transport thread drive system comprising a housing having at least one sidewall; a spirally grooved disc within said housing; a curved radial slot fitted in one sidewall of said housing, said slot receiving a support having a transport thread guide channel; a transport thread accommodated within said

spiral groove; said support having a guide channel for said transport thread; and means to drive said disc.

The means to drive said disc includes a worm gear interacting with the grooves in said disc, and a motor to drive the worm gear.

The apparatus can also include a guide arm at the top of said radial slot; said guide arm having one end rotatably mounted on a shaft; said guide arm fitted at the bottom thereof with a groove having a first end and a second end, said first end connected to the guide channel in the support, and the second end connected to the outlet in the housing.

In an further embodiment the apparatus may include a patient belt adapted to retain applicators in the body of a patient; said belt adapted to be disposed on the body of a patient to be treated; said belt is provided with a connector to which on one side a multi-channel socket connector can be connected and on the other side a number of single transfer tubes can be connected for delivery of radioactive source assemblies to a patient. In this manner the applicator will be constantly in the right place in the patient, so that the patient after each radiation and after the radioactive material has been brought back in the container can be uncoupled and freely walk around for the next radiation can be easily coupled after which the radioactive material can be easily brought in place.

In a further elaboration of the invention the transport thread drive system can comprise a housing having at least one sidewall; a spirally curved disc within said housing; a radial slot fitted in one sidewall of said housing, said slot receiving a support having a transport thread guide channel; a transport thread accommodated within said spiral groove; and means to drive said disc.

Further in the transport thread drive system the means to drive the disc includes a worm gear coacting with the grooves in said disc and a motor to drive said worm gear.

The transport thread connector can comprise a transport thread; said transport thread fitted with a gripper having gripper arms adapted for coaction with a head.

For the sake of completeness it is pointed to the European patent application no. 0 012 004 (Parsons et al) which shows an apparatus for positioning a radioactive source material in one applicator implanted in the body of a patient, in which apparatus a transport wheel is disposed behind the intermediate container is also used for advancing radioactive material through a flexible pipe. However, there is no disclosure of a needle disposed in the respective cavity of the patient, which needle is connected through a body-mounted patient connector adapted to coact with a machine connector disposed at the end of a flexible hose. There is no provision in the Parsons et al. apparatus for accurate control of the position of the radioactive material.

Further US—A—3,088,032 Brunton shows a

compressed air source connected to drive a radiation source to an exposure tube. Shimanckas (US—A—2 947 194) shows a drive gear comprising a disc driven cable. Van't Hooft (US—A—4 233 517) teaches a method to detect the position of radioactive material pneumatically. Further similarities, however, are not there.

The apparatus according to the invention have the advantage that the radioactive material can be brought accurately and without the risk of contamination of the operator, at the proper place in the body of a patient.

One embodiment of an apparatus for treating the part of a body with radioactive material will now be described, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 is a diagrammatic side view of an apparatus for treating the part of a body with radioactive material;

Fig. 2 shows a storage container employed when using the apparatus shown in Fig. 1;

Fig. 3 shows an enlarged detail of the apparatus shown in Fig. 1;

Fig. 4 shows an enlarged detail of the apparatus shown in Fig. 3;

Fig. 5 shows a perspective bottom view of the guide;

Fig. 6 shows an enlarged detail of the apparatus shown in Fig. 1;

Fig. 7 shows the enlarged transport thread with coupling elements used in the apparatus shown in Figs. 1—6 for transporting radioactive material;

Fig. 8 is a perspective view of a second embodiment of the apparatus according to the invention;

Fig. 9 is a diagrammatic top view of a part of the apparatus shown in Fig. 8 when in operation;

Fig. 10 shows the enlarged detail A of the apparatus shown in Fig. 9;

Fig. 11 is a diagrammatic side view of a transport thread used in the apparatus shown in Figs. 8 and 9, and

Fig. 12 is a diagrammatic side view of a flexible rod with a tube carrying the radioactive material.

As shown in Figs. 1—7, an apparatus for treating the part of a body with radioactive material comprises a cart 1 with wheels 2 supporting a base 3 whereon a leg 4 is mounted. Leg 4 carries a housing wherein, diagrammatically shown, there are arranged an intermediate container 6, a drive mechanism 7 and a control mechanism 8. The intermediate container connects to an external tube 9 whose free end is fitted with a machine connector 10. Said machine connector 10 is adapted for coaction by means of locking members, not shown, with a patient connector 11 affixed to a patient belt 12 disposed on the body 13 of a patient to be treated. From the patient connector, there extend a plurality of patient transfer tubes 14, the ends of which are connected through needle connectors 15 to implant needles 16 disposed in a breast 17 of the patient.

The means necessary for treating a patient with radioactive material further comprise a storage container 18 (see Fig. 2), which is fitted at the top

with a plurality of connectors 19 connecting to the passages, not shown, provided within the storage container, said passages each containing a tube with radioactive material. Storage container 18 is further provided with a support 20 to which there is attached a container connector 21 corresponding with the patient connector 11. The openings in the container connector 21 connect to the bottom of a plurality of selection tubes 22 whose free ends are fitted with selection tube connectors 23 adapted for coaction with connectors 19.

As shown in Figs. 3, 4 and 5, the drive mechanism 7 comprises a disc 24 whose circumference has teeth 25 adapted for coaction with a worm 26, driven by a motor 27. The disc 24 is fitted at its top surface with a spiral groove 28 receiving a transport thread 29. Disc 24, worm 26 and motor 27 are received in a housing 30, not shown in Figs. 4 and 5 for the sake of clarity. Housing 30 contains an outlet 31 for the transport thread 29.

To ensure a proper discharge of the transport thread from the spiral groove 28 via the opening 31, there is provided in an upper plate 32 for the disc 24 a radial slot 33 wherein a support 34 can move (see the perspective bottom view shown in Fig. 5).

Support 34 is fitted with a guide channel 35 for the transport thread. As shown in Fig. 5, the support is fitted at the bottom with a lip 36 extending into the groove 28 of the disc, thus ensuring a proper guiding by the support.

The support is fitted at the top with a slot 58 wherein a guide arm 37 is disposed whose one end is rotatably mounted on a shaft 38, which adjacent outlet 31 is attached to the upper plate 32. Furthermore, the guide arm 37 is fitted at the bottom with a groove 59 whose one end connects to the guide channel 35 in the support 34, its other end connecting to the outlet 31 in the housing.

As further shown in Fig. 3, the outlet 31 connects to a tube 39, which extends with a bent portion through the intermediate container 6. The other end of the tube 39 connects via a coupling 40 to a patient transfer tube 14. A number of such patient transfer tubes 14 are received in the external tube 9 (see Fig. 1): It is observed in this respect that the patient transfer tubes disposed on the body of the patient to be treated and those, contained in the external tube 9 are indicated by the same reference numeral, since the same patient transfer tubes are concerned here which are interconnected through machine connector 10, and the patient connector 11, respectively.

As shown in Fig. 3, the coupling 40 connects to a tube 41, which is connected to the pressure vessel 43 by means of a valve 42. Tube 41, upstream of the valve 42, is connected to a pressure transducer 14.

As shown in Fig. 6, the open end of the implant needle 16 is fitted in the needle connector 15, having a bore 45 fitted with a shoulder 46. Furthermore, bore 45 is also connected to an outlet 47.

Fig. 7 finally shows the free end of the transport thread 29, fitted with a gripper or similar crimp element 48 having gripper arms 49. Said arm 49 are adapted for coaction with a head 50 connected through a rod 51, a crimp element 52, a flexible rod 53 and a crimp element 54, to a tube 55 accommodating a plurality of radioactive sources 56. Crimp element 54, at the side facing the tube 55, is fitted with a control head 57 adapted for coaction with shoulder 46 disposed in the needle connector 15 (see Fig. 6).

The apparatus is operated as follows.

When a patient has to be treated, after the required data have been entered into the control mechanism in a known manner, the cart is moved to the storage container 18 and the machine connector 10 is connected to the container connector 21. Subsequently, the selection tube connectors 23 are connected to the desired connectors 19. Then, the motor 27 of the drive mechanism 7 is put into operation, so that the transport thread 29 is moved out of the housing, with the gripper arm 49 at its front end in forward direction, via patient transfer tube 14, machine connector 10, container connector 21, the chosen selection tube 22, selection tube connector 23, connector 19 into storage container 18. During this forward movement of the transport thread, an automatic coupling takes place between the gripper arms 49 and the head 50 of the tube 55 chosen, after which the transport thread 29 is retracted until the tube 55 is present in the intermediate container 6. After all desired tubes 55 filled with radioactive sources 56 have thus been introduced in the intermediate container 6, the machine connector 10 is detached from the container connector 21, the cart 1 is moved close to the patient and then the machine connector 10 is coupled to the patient connector 11.

The motor 27 is now restarted so as to move the transport thread with a tube containing radioactive sources on its free end in forward direction via patient transfer tube 14 received in external tube 9, machine connector 10, patient connector 11, patient transfer tube 14 on the body of the patient, needle connector 15 into implant needle 16 disposed in the breast 17 of the patient. By opening valve 42, air is introduced from pressure vessel 43 via tube 41 and coupling 40 into patient transfer tube 14. The air flows along the transport thread and escapes via outlet 47. However, as soon as control head 57 contacts shoulder 46, the pressure in tube 41 will increase, which is recorded by pressure transducer 44. Pressure transducer 44 is in communication via means not shown, with motor 27 and will cause the latter to stop when the pressure in tube 41 increases due to the abutment of control head 57 against shoulder 46. This naturally implies that tube 55 with radioactive sources 56 is at its proper place in implant needle 16.

After treating the patient, the motor 27 is re-energized so that the transport thread is again wound on disc 24 until each tube 55 filled with radioactive material is present in the intermediate

container 6 and can be clamped therein. Subsequently, cart 6 is moved to storage container 18, after which tubes 55 filled with radioactive material are returned to the storage container in a manner obvious after the foregoing.

In the above described manner, there is obtained an entirely closed transport system for the flexible transport thread, so that each time an accurate positioning of the tube 55 filled with radioactive material is possible without the risk of contamination of the operator.

Although nothing has been said in the above on given numbers of patient transfer tubes, transport threads, selection tubes, and the like, use is made in practice of a cart having an intermediate container accommodating 15 tubes. The number of patient transfer tubes 14 corresponds therewith. The storage container 18 may be provided with 45 connectors with communicating tubes for receiving therein a tube containing a source. It will be clear that the number of selection tubes in this case is also 15.

The second embodiment of the apparatus according to the invention, shown in Figs. 8—12, comprises a great many elements that correspond with those of the above described first embodiment: Corresponding parts are indicated by the same reference numerals. The perspective view illustrated in Fig. 8 shows a base 3 which, true, differs from that shown in Fig. 1, but which basically comprises the same elements. On the base there is mounted a housing 5 containing an intermediate container 6. The ends of the tubes 63 disposed in the intermediate container are basically freely accessible. Furthermore, the front of the intermediate container 6 connects to an external tube 9 whose free end is fitted with a machine connector 10.

On the base 3, there is also provided an arm 66 whose free end is fitted with means 67 for retaining, in case of non-use, machine connector 10 (shown in striped fashion in Fig. 8).

In the diagrammatic view shown in Fig. 9, the intermediate container 6 is only one of the 45 tubes 63. Said tubes connect to an external tube 9 accommodating a number of patient transfer tubes, not further indicated, corresponding with the number of tubes, which patient transfer tubes terminate in machine connector 10. Said machine connector is adapted for coaction with patient connector 11 affixed to the patient belt 12 disposed on a leg of the patient 13 to be treated. From the patient connector there extend a plurality of patient transfer tubes 14 whose ends are connected through needle connectors 15 to implant needles 16 introduced into the patient's uterus, not further indicated.

As shown in Fig. 10, each tube 63 may be fitted at its free end with a restriction 64 through which can pass the head 50 but not the shoulder 68 of crimp element 52 (see Fig. 12): In this position rod 51 is adapted for coaction with a blocking bracket 65, which may have any form but which may be provided e.g. with a slotted opening of varying slot width.

As further shown in Fig. 11, for displacing the flexible rod 53 and the tube 55 with radioactive sources 56, use is made of a manual transport thread 60, one end of which is fitted with a pusher 61 and the opposite end with a gripper 62, which is basically identical to the gripper 48 (see Fig. 7).

Since the operation of the apparatus will be clear after the above, this will not be further described herein.

It is finally observed that a great many modifications are possible without departing from the scope of the present invention.

Claims

1. Apparatus for positioning radioactive source material in at least one hollow implant needle implanted in the body of a patient comprising:

a container (6) for storing at least one radioactive source assembly (55);

said container (6) containing radioactive source assemblies (55);

a transfer tube (14) having a first end connected to the container and a second end for connecting the tube via a needle connector (15) with the at least one implant needle (16);

mechanical means to drive the radioactive source assembly from the container through the transfer tube to the at least one implant needle;

characterized by the needle connector (15) having a bore (45) fitted with a shoulder (46) and connected to an outlet (47);

a source of compressed air (43) by which air is introduced into the transfer tube (14), the air passing through the transfer tube (14) and escaping via said outlet (47);

a control head (57) near the radioactive source assembly (55), which control head (57), adapted and configured to seat in said shoulder (46) when the radioactive source assembly has been positioned in the at least one hollow implant needle;

and means to detect a pressure change in said transfer tube, which causes the mechanical drive means to stop when the pressure in the transfer tube increases due to abutment of the control head (57) against said shoulder (46).

2. The apparatus of claim 1, wherein the means to drive the radioactive source assembly (55, 56) comprises:

a transport thread (29) carrying the radioactive source assembly (56);

said transport thread (29) fitted with a gripper (48) having gripper arms (49) adapted for coaction with a head (50);

a head connected to the radioactive source assembly.

3. The apparatus of claim 1 or 2, further including a transport thread drive system comprising:

a housing (30) having at least one sidewall;

a spirally (24) grooved disc within said housing;

a curved radial slot (33) fitted in one sidewall of said housing, said slot receiving a support (34) having a transport thread guide channel (35);

a transport thread (29) accommodated within said spiral groove (28);

said support having a guide channel (35) for said transport thread;

and means (27) to drive said disc.

4. The apparatus of claim 3, wherein the means to drive said disc includes a worm gear interacting with the grooves in said disc, and a motor to drive a worm gear.

5. The apparatus of claim 3 further including a guide arm (37) at the top of said radial slot (33); said guide arm having one end rotatably mounted on a shaft (38);

said guide arm fitted at the bottom thereof with a groove (59) having a first end and a second end, said first end connected to the guide channel in the support, and the second end connected to the outlet in the housing.

6. Apparatus according to any one of claims 1—5, further including a patient belt (12) adapted to retain applicators (16) in the body of a patient (13);

said belt adapted to be disposed on the body of a patient to be treated;

said belt is provided with a connector (11) to which on one side a single transfer tube or a multi-channel socket connector (10) can be connected and on the other side a number of single transfer tubes (14) can be connected for delivery of radioactive source assemblies to a patient.

7. Apparatus according to any one of the claims 1—6 having a transport thread drive system (7) comprising:

a housing (30) having at least one sidewall;

a spirally curved disc (24) within said housing;

a radial slot (33) fitted in one sidewall of said housing, said slot receiving a support (34) having a transport thread guide channel (35);

a transport thread (29) accommodated within said spiral groove (28);

and means (27) to drive said disc.

8. Apparatus according to claim 7 wherein the means to drive the disc (24) includes a worm gear (26) coacting with the grooves in said disc and a motor (27) to drive said worm gear.

9. Apparatus according to any one of the claims 1—8 comprising:

a transport thread (29);

said transport thread fitted with a gripper (48) having gripper arms (49) adapted for coaction with a head (50).

10. The apparatus of claim 1 wherein said stop mechanism comprises:

a shoulder (46);

an air escape means (47) in the connecting tube (14) behind said shoulder and adapted and configured so as to enable air to pass from inside of the connecting tube to outside of the connecting tube.

11. The apparatus of claim 1 wherein the control head (57) is behind the radioactive source material.

Patentansprüche

1. Gerät zum Einbringen radioaktiven Quellenmaterials in wenigstens eine hohle Implantationsnadel, die in dem Körper eines Patienten implantiert ist, mit:

einem Behälter (6) zum Aufnehmen wenigstens einer radioaktiven Quellenzusammensetzung (55), wobei der Behälter (6) radioaktive Quellenzusammensetzung (55) enthält;

einer Übertragungsröhre (14), deren erstes Ende an dem Behälter angebracht ist und deren zweites Ende zum Verbinden der Röhre über einen Nadelanschluß (15) mit wenigstens einer Implantationsnadel (16) vorgesehen ist;

mechanischen Antriebsmitteln zum Antreiben der radioaktiven Quellenzusammensetzung von dem Behälter durch die Überleitungsröhre zu wenigstens einer Implantationsnadel, dadurch gekennzeichnet, daß der Nadelanschluß (15) eine Bohrung (45) aufweist, die mit einer Schulter (46) versehen ist und mit einem Ausgang (47) verbunden ist;

daß eine Druckluftquelle (43) vorgesehen ist, durch welche Luft in die Übertragungsröhre (14) derart eingeführt wird, daß die Luft durch die Übertragungsröhre (14) hindurchfließt und durch den Ausgang (47) entweicht;

daß ein Steuerkopf (57) nahe der radioaktiven Quellenzusammensetzung (55) derart gestaltet ist, daß er in der Schulter (46) sitzt, wenn die radioaktive Quellenzusammensetzung in der wenigstens einen hohlen Implantationsnadel eingebracht ist, und daß Mittel zum Erkennen einer Druckänderung in der Übertragungsröhre vorgesehen sind, welche die mechanischen Antriebsmittel zum Anhalten steuern, wenn der Druck in der Übertragungsröhre infolge Anstoßens des Steuerkopfes (57) an die Schulter (46) ansteigt.

2. Gerät nach Anspruch 1, dadurch gekennzeichnet, daß die Antriebsmittel zum Antreiben der radioaktiven Quellenzusammensetzung (55, 56) eine Transportschnecke (29) umfassen, welche die radioaktive Quellenzusammensetzung (56) trägt; daß die Transportschnecke (29) mit einem Greifer (48) mit Greiferarmen (49) versehen ist, die zum Zusammenwirken mit einem Kopf (50) ausgebildet sind;

und daß die Antriebsmittel einen Kopf umfassen, der mit der radioaktiven Quellenzusammensetzung verbunden ist.

3. Gerät nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß es ferner ein Transportschneckenantriebssystem aufweist, welches umfaßt:

eine Gehäuse (30) mit wenigstens einer Seitenwand;

eine Scheibe (24) mit einem Spiralgang innerhalb des Gehäuses;

einen gekrümmten radialen Schlitz (33), der in einer Seitenwand des Gehäuses ausgebildet ist, daß der Schlitz einen Support (34) mit einem Transportschneckenführungs kanal (35) aufnimmt;

eine Transportschnecke (29), die in dem Spiralgang (28) untergebracht ist,

daß der Support einen Führungskanal (35) für die Transportschnecke aufweist;

und daß das Transportschneckenantriebssystem Mittel (27) zum Antreiben der Scheibe umfaßt.

4. Gerät nach Anspruch 3, dadurch gekennzeichnet, daß die Mittel zum Treiben der Scheibe ein Schneckenrad umfassen, welches mit den Gängen in der Schiebe in Eingriff steht, sowie einen Motor zum Antreiben des Schneckenrades umfassen.

5. Gerät nach Anspruch 3, dadurch gekennzeichnet, daß es weiterhin einen Führungsarm (37) oben auf dem radialen Schlitz (33) aufweist; daß ein Ende des Führungsarms drehbar an einem Zapfen (38) angebracht ist;

daß der Führungsarm an seiner Unterseite mit einem Schlitz (59) mit einem ersten Ende und einem zweiten Ende versehen ist, daß das erste Ende mit dem Führungskanal in dem Support in Verbindung steht und das zweite Ende mit dem Auslaß in dem Gehäuse verbunden ist.

6. Gerät nach einem der Ansprüche 1—5, dadurch gekennzeichnet, daß es weiterhin einen Patientengürtel (12) aufweist, der dazu eingerichtet ist, die Applikatoren (16) in dem Körper eines Patienten (13) zu halten;

daß der Gürtel dazu eingerichtet ist, an dem Körper des zu behandelnden Patienten angebracht zu werden;

und daß der Gürtel mit einem Anschluß (11) versehen ist, an dessen einer Seite eine Einzel-Übertragungsröhre oder ein Mehrfach-Kanalanschlußstück (10) angebracht werden kann und an dessen anderer Seite eine Reihe Einzel-Übertragungsröhren (14) zur Abgabe der radioaktiven Quellenzusammensetzungen an einen Patienten angeschlossen werden können.

7. Gerät nach einem der Ansprüche 1—6, dadurch gekennzeichnet, daß das Transportschneckenantriebssystem (7) umfaßt;

eine Gehäuse (30) mit wenigstens einer Seitenwand;

eine Spiralkurvenscheibe (24) innerhalb des Gehäuses;

einen radialen Schlitz (33), der in einer Seitenwand des Gehäuses angebracht ist und einen Support (34) mit einem Transportschneckenführungs kanal (35) aufnimmt;

eine Transportschnecke (29), die in dem Spiralgang (28) untergebracht ist;

sowie Mittel (27) zum Antreiben der Scheibe.

8. Gerät nach Anspruch 7, dadurch gekennzeichnet, daß die Mittel zum Antreiben der Schiebe (24) ein Schneckenrad (26) umfassen, welches mit den Gängen in der Schiebe in Eingriff steht und mit einem Motor (27) zum Antreiben des Schneckenrades in Verbindung steht.

9. Gerät nach einem der Ansprüche 1—8, dadurch gekennzeichnet, daß es eine Transportschnecke (29) umfaßt, die mit einem Greifer (48) mit Greiferarmen (49) versehen ist, die zum Zusammenwirken mit einem Kopf (50) ausgebil-

det sind.

10. Gerät nach Anspruch 1, dadurch gekennzeichnet, daß der Anhaltemechanismus eine Schulter (46) sowie einen Luftauslaß (47) umfaßt, der in der Verbindungsröhre hinter der Schulter angeordnet ist und derart gestaltet ist, daß er Luft von dem Inneren der Verbindungsröhre nach deren Außenseite leitet.

11. Gerät nach Anspruch 1, dadurch gekennzeichnet, daß der Steuarkopf (57) hinter der radiaktiven Quellenzusammensetzung angeordnet ist.

Revendications

1. Dispositif pour positionner un matériau formant source radioactive dans au moins une aiguille creuse formant implant, implantée dans le corps d'un patient, comprenant:

un récipient (6) servant à stocker au moins un ensemble formant source radioactive (55);

ledit récipient (6) contenant des ensembles formant sources radioactives (55);

un tube de transfert (14) possédant une première extrémité raccordée au récipient et une seconde extrémité servant à raccorder le tube par l'intermédiaire d'un connecteur d'aiguille (15) à au moins une aiguille formant implant (16);

des moyens mécaniques servant à entraîner l'ensemble formant source radioactive depuis le récipient par l'intermédiaire du tube de transfert jusqu'à au moins une aiguille formant implant;

caractérisé en ce que le connecteur (15) de l'aiguille possède un perçage (45) pourvu d'un épaulement (46) raccordé à une sortie (47); et

en ce qu'il est prévu

une source d'air comprimé (43), au moyen de laquelle de l'air est introduit dans le tube de transfert (14), l'air transverant le tube de transfert (14) et s'échappant par ladite sortie (47);

une tête de commande (57) située à proximité de l'ensemble formant source radioactive (55), laquelle tête de commande (57) est adaptée et agencée de manière à être logée dans ledit épaulement (46) lorsque l'ensemble formant source radioactive a été positionné dans au moins une aiguille creuse formant implant; et

des moyens pour détecter, dans ledit tube de transmission, une variation de pression qui provoque l'arrêt des moyens d'entraînement mécanique lorsque la pression dans le tube de transfert augmente en raison de la venue en butée de la tête de commande (57) contre l'épaulement (46).

2. Dispositif selon la revendication 1, dans lequel les moyens pour entraîner l'ensemble formant source radioactive (55, 56) comprennent:

un fil d'entraînement (29) portant l'ensemble formant source radioactive (56);

ledit fil d'entraînement (29) étant équipé d'un organe de préhension (48) comportant des bras (49) aptes à coopérer avec une tête (5);

une tête raccordée à l'ensemble formant source radioactive.

3. Dispositif selon la revendication 1 ou 2, comportant en outre un système d'entraînement

du fil d'entraînement, comprenant:

un boîtier (30) possédant au moins une paroi latérale;

un disque (24) pourvu d'une gorge spirale et situé à l'intérieur dudit boîtier.

une fente radiale courbe (33) ménagée dans une paroi latérale dudit boîtier, ladite fente logeant un support (34) possédant un conduit (35) de guidage du fil d'entraînement;

un fil d'entraînement (29) logé à l'intérieur de ladite gorge spirale (26);

ledit support possédant un conduit de guidage (35) pour ledit fil d'entraînement; et

des moyens (27) pour entraîner ledit disque.

4. Dispositif selon la revendication 3, dans lequel les moyens servant à entraîner ledit disque incluent une vis sans fin coopérant avec les gorges ménagées dans ledit disque, et un moteur pour entraîner la vis sans fin.

5. Dispositif selon la revendication 3, comportant en outre un bras de guidage (35) situé à la partie supérieure de ladite fente radiale (33);

ledit bras de guidage possédant une extrémité montée rotative sur un arbre (38);

ledit bras de guidage comportant, au niveau de sa partie inférieure, une gorge (59) possédant une première extrémité et une seconde extrémité, ladite première extrémité étant raccordée au conduit de guidage ménagé dans le support, et la seconde extrémité étant raccordée à la sortie ménagée dans le boîtier.

6. Dispositif selon l'une quelconque des revendications 1—5, comportant en outre une ceinture (12) pour patient, apte à maintenir des applicateurs (16) dans le corps d'un patient (13);

ladite ceinture étant apte à être placée sur le corps d'un patient devant être traité;

ladite ceinture étant équipée d'un connecteur (11) auquel peut être raccordé, d'un côté, un seul tube de transfert ou un connecteur (10) à douilles à conduits multiples et sur l'autre côté duquel peut être raccordé un certain nombre de tubes individuels de transfert (14) permettant d'appliquer des ensembles formant sources radioactives à un patient.

7. Dispositif selon l'une quelconque des revendications 1—6 comportant un système (7) d'entraînement d'un fil, d'entraînement, comprenant:

un boîtier (30) possédant une paroi latérale;

un disque (24) comportant des gorges spirales et situé à l'intérieur dudit boîtier;

une fente radiale (33) montée dans une paroi latérale dudit boîtier, et une fente recevant un support (34) possédant un conduit (35) de guidage d'un fil d'entraînement;

un fil d'entraînement (29) logé dans ladite gorge spirale (26); et

des moyens (27) pour entraîner ledit disque.

8. Dispositif selon la revendication 7, dans lequel les moyens pour entraîner le disque (24) incluent une vis sans fin (26) coopérant avec les gorges ménagées dans ledit disque, et un moteur (27) servant à entraîner ladite vis sans fin.

9. Dispositif selon l'une quelconque des revendications 1—8, comprenant:

un fil d'entraînement (29);

ledit fil d'entraînement étant équipé d'un dispositif de préhension (48) possédant des bras (49) aptes à coopérer avec une tête (50).

10. Dispositif selon la revendication 1, dans lequel ledit mécanisme de butée comprend:

un épaulement (46);

des moyens d'échappement d'air (47) situés

dans le tube de raccordement (14) en arrière dudit épaulement et adaptés et agencés de manière à permettre le passage de l'air depuis l'intérieur du tube de raccordement en direction de l'extérieur de ce tube.

11. Dispositif selon la revendication 1, dans lequel la tête de commande (55) est située en arrière du matériau formant source radioactive.

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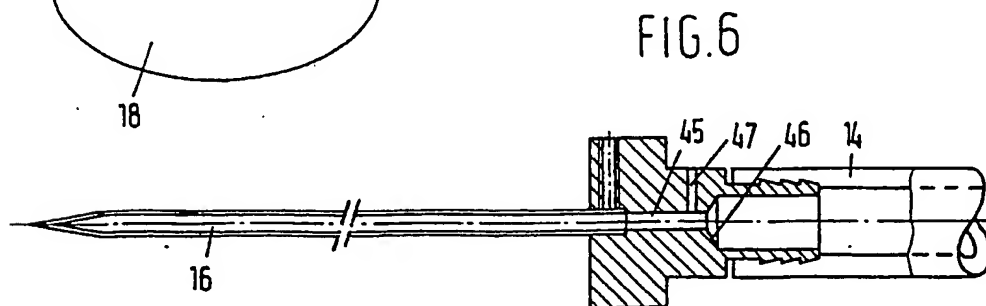
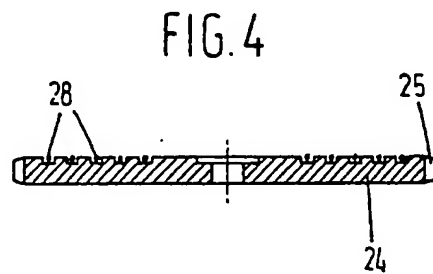
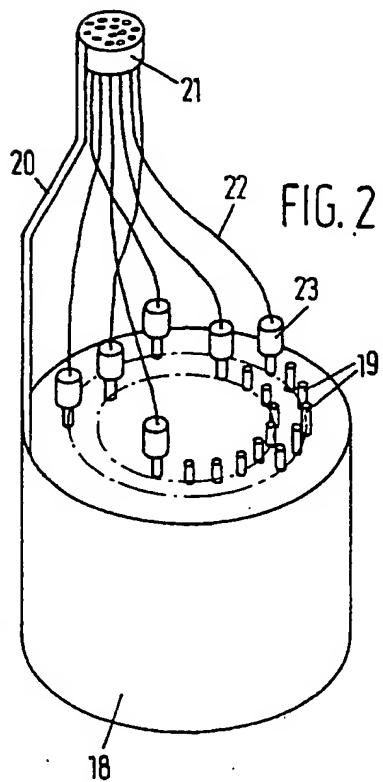
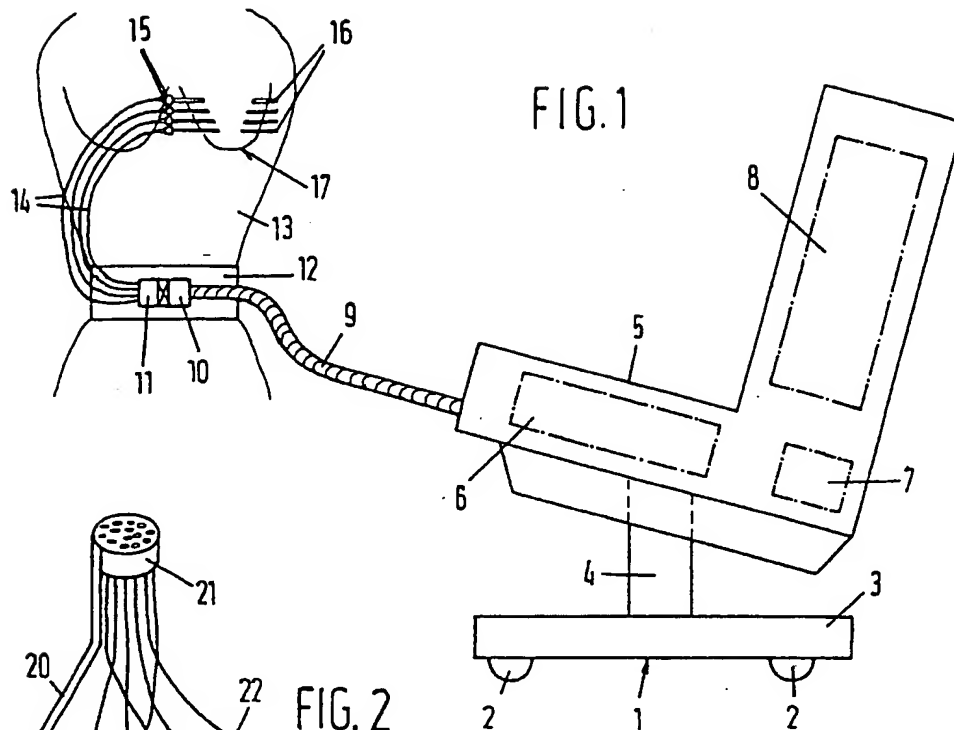
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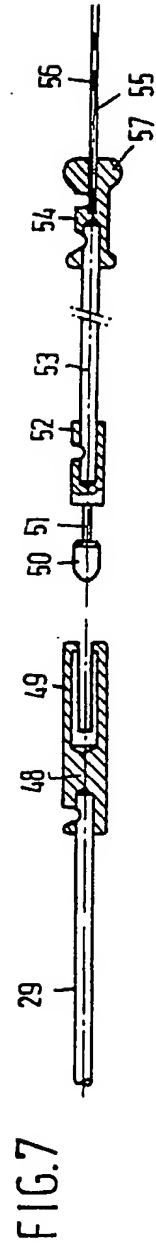
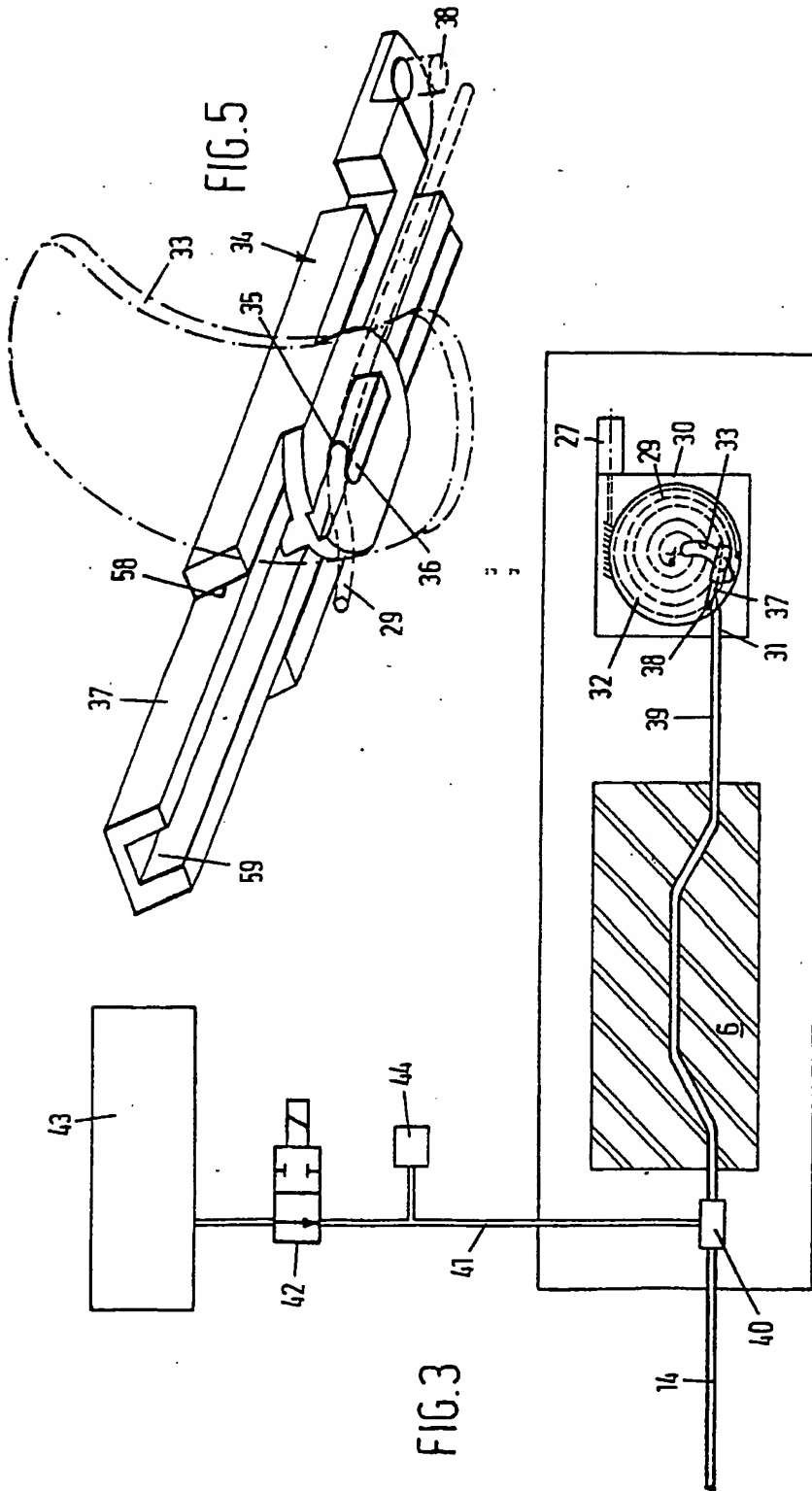
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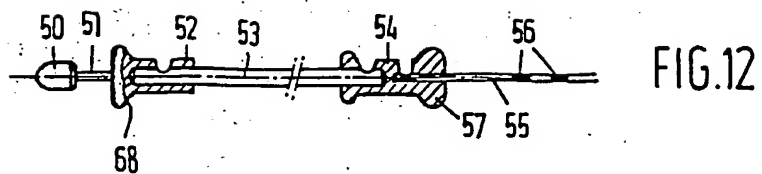
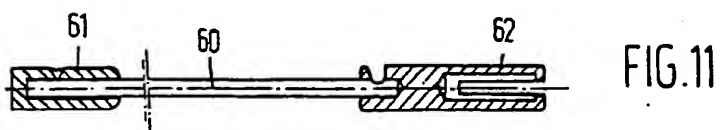
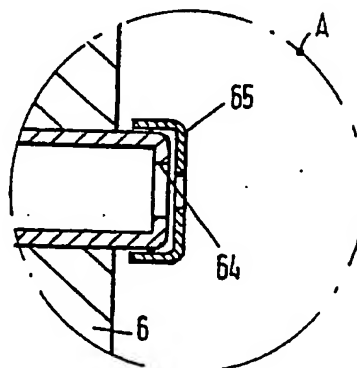
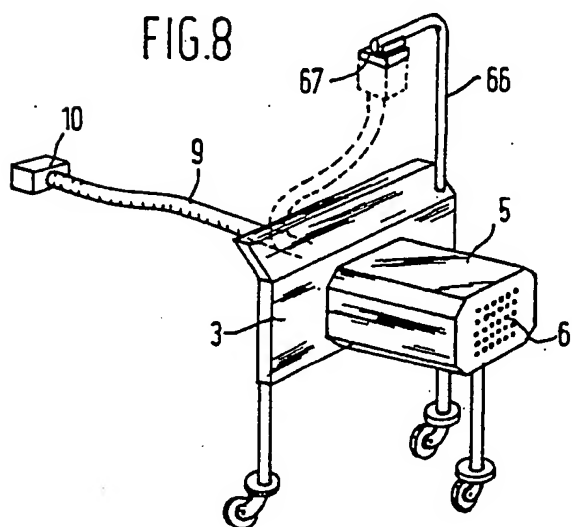
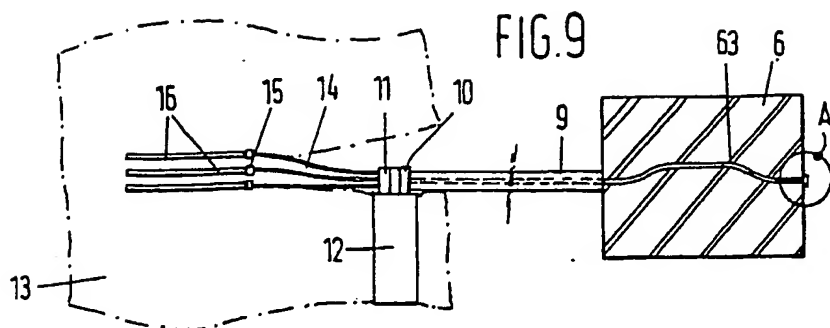
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